

CLAIMS

What is claimed is:

1. A blade for an impeller having a root portion, a tip portion, a leading edge, a trailing edge, said blade having:

a cross-sectional shape, taken anywhere along a radius of said blade, characterized by a maximum thickness located substantially constantly as a percentage of chord and a maximum camber located substantially constantly as percentage of chord.

2. A blade for an impeller having a root portion, a tip portion, a leading edge, a trailing edge, said blade having:

a cross-sectional shape, taken anywhere along a radius of said blade, characterized by a maximum thickness located substantially constantly between about 16% chord to about 23% chord and a maximum camber located substantially constantly between about 40% chord to about 51% chord.

3. A blade for an impeller having a root portion, a tip portion, a leading edge, a trailing edge, said blade being characterized:

in plan form wherein the blade is varied from said root portion to said tip portion with a maximum chord located between said root portion and said tip portion, said leading edge and said trailing edge of said blade are convex from said root portion to said tip portion; and

a cross-sectional shape, taken anywhere along a radius of said blade, characterized by a maximum thickness located substantially constantly as a percentage of chord.

4. A blade for an impeller having a root portion, a tip portion, a leading edge, a trailing edge, said blade being characterized:

in plan form wherein the blade is varied from said root portion to said tip portion with a maximum chord located between said root portion and said tip portion, said leading edge and said trailing edge of said blade are convex from said root portion to said tip portion; and

a cross-sectional shape, taken anywhere along a radius of said blade, characterized by a maximum camber located substantially constantly as percentage of chord.

5. The blade of Claim 3 where said maximum thickness is located substantially constantly between about 16% chord to about 23% chord.

6. The blade of Claim 4 where said maximum camber located substantially constantly between about 40% chord to about 51% chord.

7. A blade for an impeller having a root portion, a tip portion, a leading edge, a trailing edge, said blade being characterized:

in plan form wherein the blade is varied from said root portion to said tip portion with a maximum chord located between said root portion and said tip portion, said leading edge and said trailing edge of said blade are convex from said root portion to said tip portion; and

a cross-sectional shape, taken anywhere along a radius of said blade, characterized by said leading edge being similar to a parabola in shape, a convex upper surface, and a lower surface which is convex towards said leading edge and concave towards said trailing edge.

8. A blade for an impeller having a root portion, a tip portion, a leading edge, a trailing edge, said blade having:

a cross-sectional shape, taken anywhere along a radius of said blade, characterized by a maximum thickness located substantially constantly as a percentage of chord, a maximum camber located substantially constantly as percentage of chord, said leading edge being similar to a parabola in shape, a convex upper surface, and a lower surface which is convex towards said leading edge and concave towards said trailing edge.

9. A method for determining an optimum camber line and thickness distributions in a blade for an impeller having a root portion, a tip portion, a leading edge and a trailing edge, comprising the steps of:

determining a series of fan performance parameters and design constraints;

utilization of Bezier curves to determine the appropriate camber line and thickness distributions utilizing the equation

$$F(u) = \sum_{k=0}^{k_{\text{max}}} f_k B_k^n(u)$$

wherein:

F(u) represents the solution of the Bezier curve;

u is a parameter that varies linearly between 0 and 1, ($u = 0$ at the leading edge and $u = 1$ at the trailing edge);

f_k is a one-dimensional array of Bezier control points;

$B_k^n(u)$ is the Bernstein polynomial of degree n ;

$$B_k^n(u) = \binom{n}{k} u^k (1-u)^{n-k};$$

$n+1$ is the number of Bezier control points, and

$\binom{n}{i}$ are the binomial coefficients as defined in CRC Standard Mathematical Tables, 22nd Ed., 1974, p. 627;

initial values of the Bezier control points are selected;

$F(u)$ is separately applied to determine the camber line x and y coordinates as well as the thickness distribution;

conducting an inviscid flow analysis of the to determine a surface velocity distribution and work distribution for the resultant camber line and thickness

distributions;

altering the Bezier control points, acquiring different camber and thickness distributions, repeating the process until a favorable solution is achieved.

10. The method disclosed in Claim 9 wherein:

the fan performance parameters include a volumetric flow rate, a shaft speed and inlet air density.

11. The method disclosed in Claim 9 wherein:

the design constraints include fan size, fan weight, motor input power, and acoustic noise signature.

12. The method disclosed in Claim 9 wherein:

the fan performance parameters include a volumetric flow rate, a shaft speed and inlet air density; and

the design constraints include fan size, fan weight, motor input power, and acoustic noise signature.

13. The method disclosed in Claim 12 wherein:

the volumetric flow rate is approximately 225 to 255 ft³/min; and
the shaft speed is approximately 3200 to 3600 rpm.

14. The method disclosed in Claim 12 wherein:

the volumetric flow rate is approximately 240 ft³/min;
the shaft speed is approximately 3400 rpm;
inlet air density is approximately 0.075 lbs/ft³; and
the axial width of the fan is approximately 1 inch.

15. The method disclosed in Claim 9 wherein:

n is chosen to be 18 so that the resultant Bezier equations are an 18th degree polynomial.

16. The method disclosed in Claim 9 wherein:

the surface velocity distribution does not promote boundary layer separation.

17. The method disclosed in Claim 9 wherein:

the work distribution locates the maximum work distribution at a point between the root portion and the tip portion.